MEMORANDUM **CH2MHILL**

PCB Soil Sampling at Webster Street Property, First South Properties, LLC.

TO: Jerry Bartlett/Emerald Services, Inc.

COPIES: Carolyn Kossik/CH2M HILL

FROM: Rachel Chang/CH2M HILL

DATE: May 23, 2005

Introduction

The purpose of this memorandum is to summarize the field procedures and the results of the PCB soil investigation conducted at the Webster Street property located at 7343 East Marginal Way, Seattle, Washington (Figure 1).

The Webster Street property is a 4-acre property owned by First South Properties, LLC. It is also known as the First South Properties and Parcel E. The property is zoned industrial. It is located north of Boeing Plant 2 between Slip 4 and East Marginal Way. Adjacent property owners include The Boeing Company to the south and Crowley Marine Services (Crowley) to the west. Crowley owns Slip 4 and up to 10 feet above the mean high water mark along the eastern bank of Slip 4 adjacent to Webster Street property. The Webster Street property is currently used for dispatch and short- and long-term equipment and truck trailer storage by Emerald Services, Inc. (Emerald). The property is partially paved. An office trailer is located on the property. One small building is located along the south fence line that borders Boeing property. According to Emerald personnel, no industrial processes are conducted at the site.

In July 2004, the City of Seattle collected sediment samples in and around Slip 4. The results of this sampling event were described in the report titled *Lower Duwamish Waterway Slip 4 Early Action Area: Cruise and Data Report* (Integral, 2004). Elevated concentrations of polychlorinated biphenyls (PCBs) were found in sediments along the bank below the Webster Street property. These sample locations have been identified on Figure 2 with the analytical results of the sampling compiled in Table 1.

In April 2005, Emerald conducted a soil investigation at the request of Ecology in an attempt to determine if PCBs are present on the Webster Street property. The sample locations selected for this round of soil investigation roughly correspond to the locations sampled in the July 2004 sampling event except they are located further in land and are within the Webster Street property boundary. A copy of the Sampling and Quality Assurance Project Plan (Attachment 1) prepared for this soil investigation was forwarded to Ms. Sunny Becker of Ecology prior to sampling.

Sample Collection

On April 7, 2005, 7 surface soil samples (0 to 10 cm) plus one duplicate sample were collected above the eastern banks of Slip 4 about 10 to 20 feet inside the Webster Street Property boundary. The samples were collected following the protocols described in the Sampling and Quality Assurance Project Plan. Ms. Becker was on site to observe the sampling event. The coordinates of the sample locations were recorded using a handheld GPS for future reference. The soil sampling locations were plotted using GPS data and are shown on Figure 2.

Laboratory Analysis and QA/QC Review

The samples were analyzed by Analytical Resources Inc. (ARI) in Tukwila, Washington for PCBs using SW846 8082 and Total Organic Carbon using EPA 9060. All of the samples were extracted, analyzed, and reported by the laboratory twice. During the first round of extraction and analysis, the samples results were reported at detection limits higher than those specified in the Sampling and Quality Assurance Project Plan. At the request of CH2M HILL, the laboratory re-extracted, re-analyzed, and reported the sample results a second time with the specified detection limits. The results from these two sets of data were fairly consistent with the exception of Aroclor 1254. During the re-extraction and re-analysis, there were un-expected chromatographic interferences in 4 of the 8 samples for Aroclor 1254 causing the Aroclor 1254 results to be reported as non-detects at 10 times the expected detection limits. Since Arolcor 1254 was also detected in 4 of the 8 samples during the first analysis, it appears that Aroclor 1254 is indeed present in the samples. Therefore, it is determined that the data from the first analysis should be used for data analysis (Table 2).

The quality assurance quality control (QA/QC) measures performed by the laboratory included method blank, surrogate, laboratory spike and spike duplicate, and MS/MSD analyses. All QA/QC parameters were within their respective laboratory established control limits. At 17%, the relative percent difference for duplicate samples (FS07-BK07 and FS08-BK06) is within the expected range for soil samples. The sample results for all analyses are considered as appropriate for quantitative usage. The analytical data reports from both sets of analyses are included as Attachment 2.

Sample Results

Analytical results including TOCs, individual Aroclors, Total PCBs (calculated), and Total PCBs normalized for organic carbon (OC) (calculated) are presented in Table 2. Total PCBs were calculated by summing all detected Aroclors. When no Aroclor were detected, the single highest detection limit was reported. When one or more individual Aroclors were detected, only the detected concentrations were summed. This method of calculation is consistent with those reported in the *Lower Duwamish Waterway Slip 4 Early Action Area: Cruise and Data Report* (Integral, 2004).

The results are compared to the following regulatory standards:

- Washington State Sediment Management Standards (SMS) Sediment Quality Standards (SQS) (WAC 173-204-320) of 12,000 µg/kg (OC normalized)
- Model Toxics Control Act (MTCA) Method A Soil cleanup level for industrial land use of 10,000 µg/kg.

None of the sample results exceeded SQS or MTCA Method A for PCBs.

Conclusion

Analytical results as summarized in Table 2 indicate that detectable concentrations of PCBs, predominantly Aroclors 1254 and 1260, are present in the surface soils along the top edge of the eastern banks of Slip 4 within the Webster Street Property. Soil samples collected from 6 of the 7 locations had detectable concentrations of PCBs. The sample concentrations ranged from non-detected to 143 µg/kg for Total PCBs or non-detected to 6,200 µg/kg OC. These concentrations are well below MTCA Method A cleanup level for industrial land use of 10,000 µg/kg or SQS of 12,000 µg/kg OC.

These sample results are also well below the results reported by the City of Seattle in 2004 for samples collected in or along the banks of Slip 4 just below the Webster Street Property boundary. In particular, samples FS05-BK06, FS06-BK06, FS07-BK06, and FS08-BK06 (duplicate of FS07-BK06) were collected within 5 to 10 feet northeast of sample BK-06 collected in July of 2004 by the City of Seattle (see Table 1). The FS- sample concentrations ranged from 29 to 143 µg/kg (Table 2). By contrast, sample BK-06, which is located just outside of the Webster Street property boundary, had a detected concentration of 7,800 µg/kg (Table 1). Based on these results, it appears that the PCBs found in the vicinity of BK-06 may have been a localized concentration and does not necessarily extend to the Webster Street Property.

In addition, PCB concentrations appear to decrease considerably for samples located further inland and away from the bank of Slip 4 compared with those collected below the top of the bank (samples collected by the City of Seattle). Results for City of Seattle samples BS-02 through BS05 (located in or around bank of Slip 4) ranged from 790 µg/kg to 4,700 µg/kg (BK-02) (average of field duplicates). By comparison, sample concentrations for FS01-BK02 through FS04-BK05, which are located at least 10 to 20 feet upland from the top of the bank of Slip 4, ranged from non-detect to 107 µg/kg (FS04-BK05).

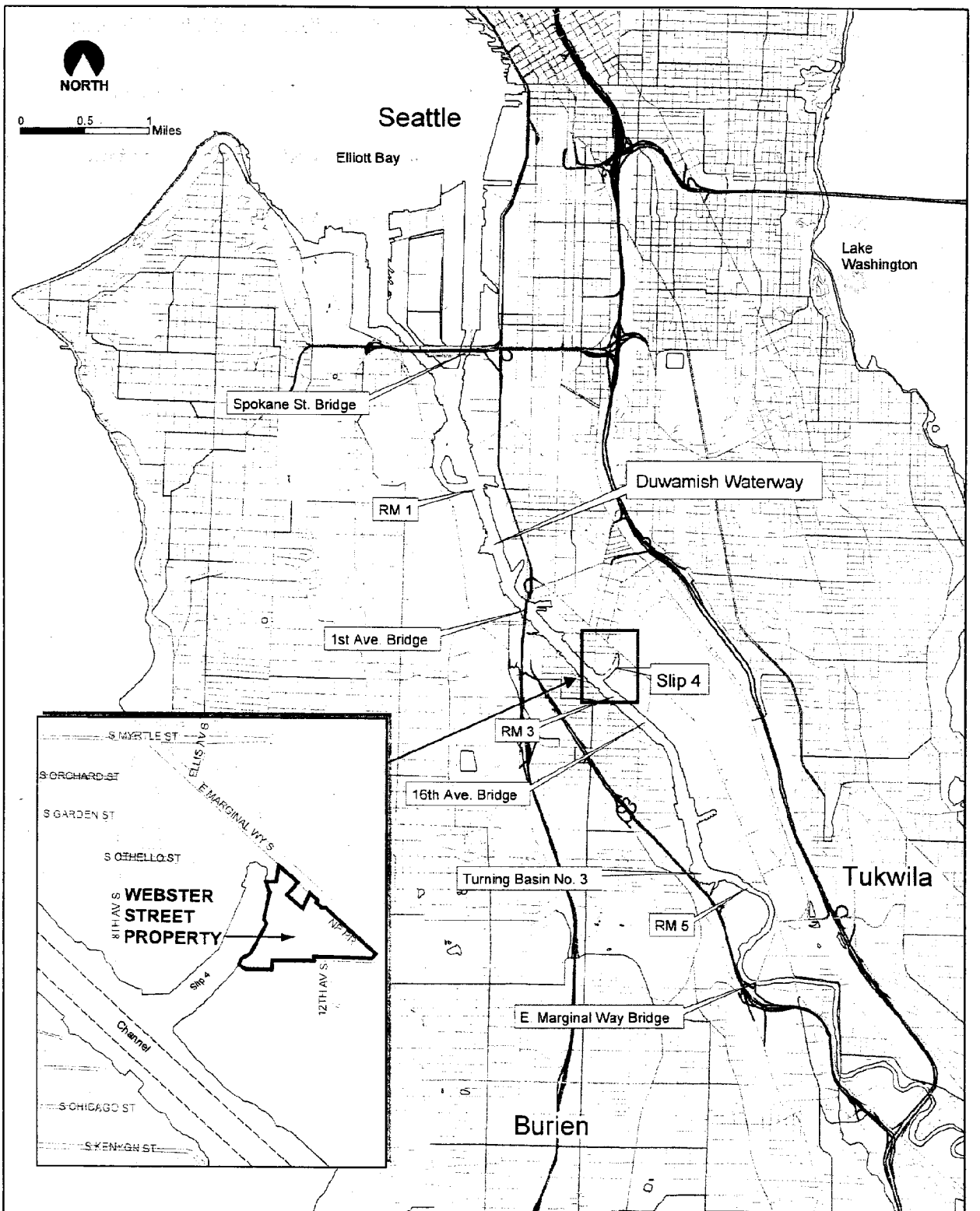
Reference

Integral Consulting Inc. 2004. *Lower Duwamish Waterway Slip 4 Early Action Area: Cruise and Data Report.* Submitted to USEPA Region 10. Submitted by City of Seattle and King County. Prepared by Integral Consulting Inc., November 10, 2004.

Attachment

1 Sampling and Quality Assurance Project Plan (CH2M HILL, April 2005)

2 Laboratory Analysis Reports



Map Feature Sources: King County GIS, Seattle Public Utilities, USACE, Ecology, and others

Source: Integral, January 2005.

Figure 1
Site Location Map
Webster Street Property PCB Soil Sampling

326634.GC.01_E032005007SEA • Fig. 1 Site Location Map • 3/28/05 • dk

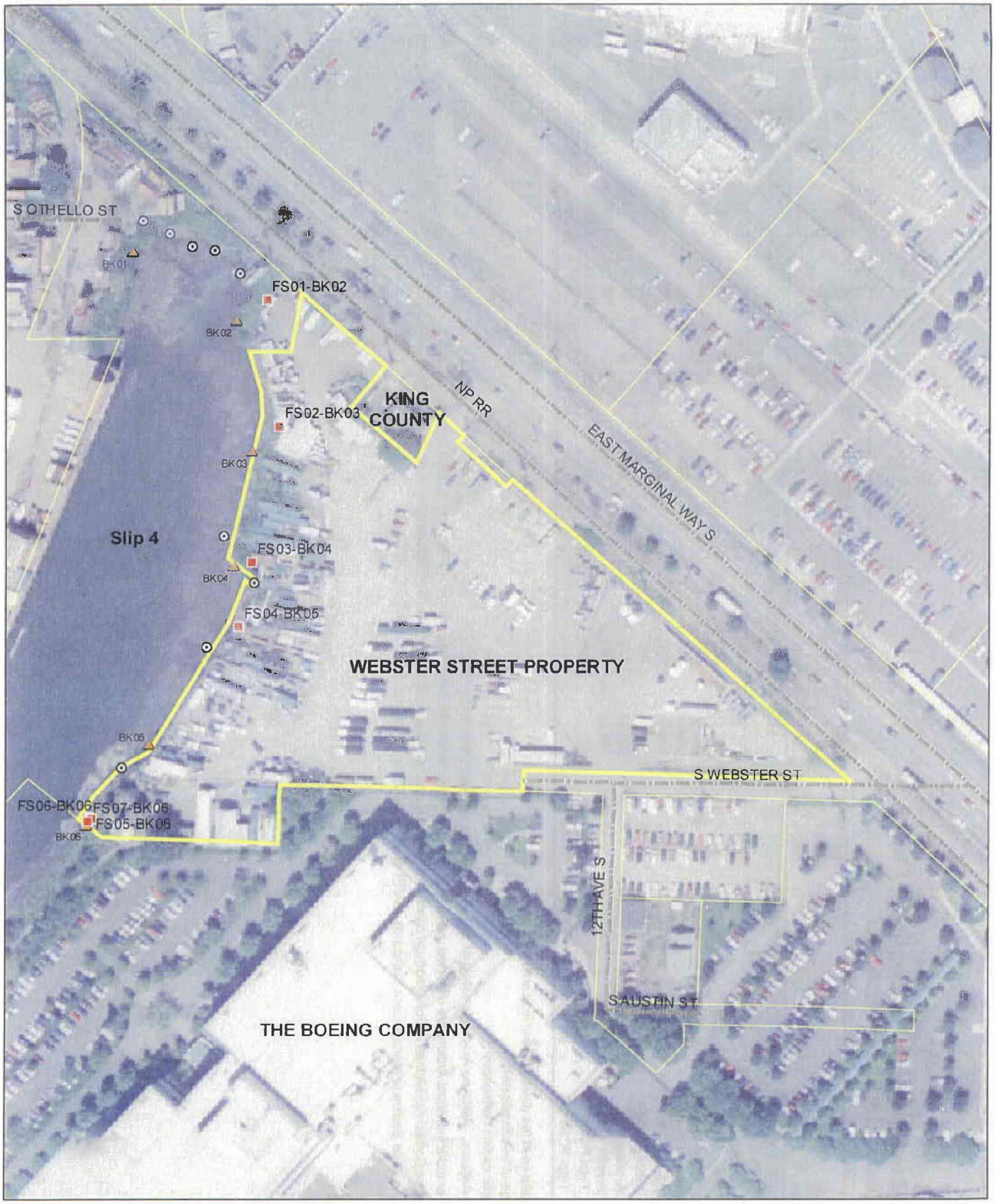


Figure 2.
Soil Sample Locations
Webster Street Property PCB Soil Sampling

File Path: P:\Northwest\Wastelndus\036534\GIS\MapDocument\GPSpoints.mxd

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Table 1
City of Seattle PCB Soil Sample Results - Sampled July 2, 2004
PCB Soil Sampling at Webster Street Property

Sample ID				BK-01	BK-02	BK-07	BK-02-Avg	BK-08	BK-03	BK-04	BK-05	BK-06
Location ID				BK-01	BK-02	BK-02-FS	BK-02-Avg	BK-02-FR	BK-03	BK-04	BK-05	BK-06
Sample Date				7/2/04	7/2/04	7/2/04	7/2/04	7/2/04	7/2/04	7/2/04	7/2/04	7/2/04
Chemical Group	**Compound**	**Units**	**Regulatory Standard**									
CONV	Total Organic Carbon	Percent	--	0.958	8.23 M	11.8	10 M	9.39	1.75	3.92	4.95	1.94
PCBs	Aroclor 1016	ug/kg	--	4 U	500 U	440 U	--	240 U	27 U	68 U	62 U	120 U
PCBs	Aroclor 1242	ug/kg	--	4 U	500 U	440 U	--	240 U	27 U	68 U	62 U	120 U
PCBs	Aroclor 1248	ug/kg	--	4 U	500 U	440 U	--	240 U	27 U	68 U	62 U	120 U
PCBs	Aroclor 1254	ug/kg	--	13	2,700	4,100	--	2,000	470	480	860	3,700
PCBs	Aroclor 1260	ug/kg	--	10	1,100	1,500	--	710	380	310	440	4,100
PCBs	Aroclor 1221	ug/kg	--	4 U	500 U	440 U	--	240 U	27 U	68 U	62 U	120 U
PCBs	Aroclor 1232	ug/kg	--	4 U	500 U	440 U	--	240 U	27 U	68 U	62 U	120 U
PCBs	Total PCBs[a]	ug/kg	10,000[b]	23	3,800	5,600	4,700 M	2,710	850	790	1,300	7,800
PCBs	Total PCBs OC	ug/kg OC	12,000[b]	2,400	--	--	47,000 M	28,900	48,600	20,200	26,300	402,000

U = Not detected at the detection limit indicated.
M = Average of field duplicates.
OC = Organic carbon normalized
[a]Sum of all Aroclors. When no Aroclor is detected, the single highest detection limit is reported.
When one or more individual Arclors are detected, only the detected concentrations are summed.
[b] Model Toxics Control Act Method A Soil Cleanup Levels for Industrial Land (WAC 173-340 Table 745-1). PCB mixtures, total value for all PCBs.
[c] Washington State Sediment Management Standards (SMS) Sediment Quality Standards (SQS) (WAC 173-204-320).

Table 2
PCB Soil Sample Results - Analyzed April 18, 2005
PCB Soil Sampling at Webster Street Property

Sample ID				FS01-BK02	FS02-BK03	FS03-BK04	FS04-BK05	FS05-BK06	FS06-BK06	FS07-BK06	FS08-BK06[d]	FS-07-Ave[d]
Sample Date				07-Apr-05	07-Apr-05	07-Apr-05	07-Apr-05	07-Apr-05	07-Apr-05	07-Apr-05	07-Apr-05	
Chemical Group	Compound	Units	Regulatory Standard									
CONV	Total Solids	Percent	--	90.40	87.20	92.10	86.30	88.00	92.90	87.60	89.10	88.35
CONV	Total Organic Carbc	Percent	--	3.33	1.50	1.24	1.26	1.44	1.54	4.55	3.14	3.85
PCBs	Aroclor 1016	ug/kg	--	16 U	16 U	16 U	17 U	16 U	16 U	16 U	16 U	--
PCBs	Aroclor 1221	ug/kg	--	16 U	16 U	16 U	17 U	16 U	16 U	16 U	16 U	--
PCBs	Aroclor 1232	ug/kg	--	16 U	16 U	16 U	17 U	16 U	16 U	16 U	16 U	--
PCBs	Aroclor 1242	ug/kg	--	16 U	16 U	16 U	17 U	16 U	16 U	16 U	16 U	--
PCBs	Aroclor 1248	ug/kg	--	16 U	16 U	16 U	17 U	16 U	16 U	16 U	16 U	--
PCBs	Aroclor 1254	ug/kg	--	16 U	32	16 U	83	16 U	16 U	43	22	32.5
PCBs	Aroclor 1260	ug/kg	--	36	61	16 U	24	32	29	100	79	89.5
PCBs	Total PCBs[a]	ug/kg	10,000[b]	36	93	16 U	107	32	29	143	101	122
PCBs	Total PCBs OC	ug/kg OC	12,000[c]	1081	6200	1290 U	8492	2222	1883	3143	3217	3180

U = Not detected at the detection limit indicated.
OC = Organic carbon normalized

[a]Sum of all Aroclors. When no Aroclor is detected, the single highest detection limit is reported.

When one or more individual Arclors are detected, only the detected concentrations are summed.

[b] Model Toxics Control Act Method A Soil Cleanup Levels for Industrial Land (WAC 173-340 Table 745-1). PCB mixtures, total value for all PCBs.

[c] Washington State Sediment Management Standards (SMS) Sediment Quality Standards (SQS) (WAC 173-204-320).

[d]FS08-BK06 is a field duplicate of FS07-BK06. FS-07-Ave is the average of the two.

ATTACHMENT 1

Sampling and Quality Assurance Project Plan

Webster Street Property, First South Properties, LLC.

7343 East Marginal Way
Seattle, Washington 98134

Prepared for
Emerald Services, Inc.

APRIL 2005

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Contents

1.0 Introduction

The purpose of this sampling and quality assurance project plan (SAP) is to describe the field activities and quality assurance/quality control (QA/QC) protocols needed to conduct a soil investigation at the Webster Street property located at 7343 East Marginal Way, Seattle, Washington (Figure 1).

The Webster Street property is a 4-acre property owned by First South Properties, LLC. It is also known as the First South Properties and Parcel E. The property is zoned industrial. It is located north of Boeing Plant 2 between Slip 4 and East Marginal Way. Adjacent property owners include the Boeing Company to the south and Crowley Marine Services (Crowley) to the west. Crowley owns Slip 4 and up to 10 feet of the mean high water mark along the eastern bank of Slip 4 adjacent to Webster Street property. The Webster Street property is currently used for short- and long-term equipment and truck trailer storage by Emerald Services, Inc. No industrial processes or buildings are present at the site. An office trailer is located on the property.

Recent sampling conducted by the City of Seattle in and around Slip 4 has found elevated concentrations of polychlorinated biphenyls (PCBs) along the bank below the Webster Street property. At the request of Ecology, soil samples will be collected at the Webster Street property in an attempt to determine if PCBs are present on the Webster Street property.

This SAP has been prepared according to the *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology, February 2001).

1.0 Previous Investigations

Following is a description of previous investigations conducted at the Webster Street property as well as adjacent Slip 4 bank and sediments.

Hart Crowser PCB Sampling - 1989

As part of the 1989 environmental site assessment conducted by First South Properties, L.L.C., one soil sample and one groundwater sample were collected and analyzed for PCBs at the Webster Street property. Sample HC-3 was located on the eastern portion of the Webster Street property. There were no detections of PCBs in either the soil or groundwater sampled and analyzed from HC-3 in 1989 (Hart Crowser, 2005).

Miscellaneous Sampling at Slip 4 and Parcels D and F – 1989-1991

As reported in Hart Crowser's February 2, 2005 memorandum (Hart Crowser, 2005), other soil, groundwater, and sediment sampling and analysis occurred on nearby properties and in Slip 4 between 1989 and 1991. PCB analyses were conducted on several surface and subsurface soil and groundwater samples from Parcels D and F (along western bank of Slip 4) and sediment samples from Slip 4. PCBs were detected in the sediment samples in Slip 4 and soil samples from Parcel D and F. None of the groundwater samples analyzed from Parcels D or F had detectable concentrations of PCBs (Hart Crowser, 2005). Potential sources of PCBs in the sediments at the head of Slip 4 were attributed to past outfall

discharges from Seattle City Light's Georgetown steam plant facility and Boeing industrial facilities (Hart Crowser, 2005).

TPH Independent Remedial Action - 1991 through 1997

In 1991, an independent remedial action was completed at the site which consisted of a groundwater and soil quality assessment along with removal of five underground storage tanks (UST) and associated contaminated soils (Hart Crowser, 1996). Additional cleanups were conducted between 1991 and 1996. On October 21, 1997 Ecology issued a No Further Action letter (NFA) to First South Properties, LLC, owner of the Webster Street Property (Ecology, 1997). According to the NFA letter, the property was cleaned in accordance with MTCA requirements. However, the NFA letter stipulated that groundwater at the site must be sampled and analyzed for TPH-diesel semi-annually until TPH concentrations in all on-site monitoring wells fall below the MTCA Method A cleanup level of 1 mg/L for four consecutive sampling events. In a letter issued by Ecology dated May 6, 1998, Ecology determined that the groundwater monitoring required by the 1997 NFA letter has successfully demonstrated that TPH remaining in the soil at the site does not pose a threat to human health or the environment.

City of Seattle Lower Duwamish Waterway Slip 4 Early Action Area Boundary Definition PCB Sampling - 2004

In July 2004, six bank sediment samples (BK-01 through BK-06) were collected by the City of Seattle on properties belonging to Crowley (BK-01 through BK-05) and Boeing (BK-06). These samples were located along the eastern bank of Slip 4 below the Webster Street property at a bank elevation of +10 feet mean lower low watermark (MLLW). The samples were analyzed for PCB Aroclors and mercury. The purpose of the sampling was to determine whether the banks are sources of contamination to sediments in the slip (Integral, July 2004). The top of bank elevation in Slip 4 is approximately +12 to +16 ft MLLW. The locations of these bank samples as well as surface sediment samples collected within Slip 4 are shown on Figure 2. As noted in the Integral's January 2005 report, in the vicinity of the southeast Slip 4 shoreline, where bank samples exceeded SQS at +10 feet MLLW, the fill/native interface generally occurs at elevations ranging from +4 to +11 feet MLLW. Therefore, the bank samples collected may represent fill material or some mixture of fill material and sedimentary deposits. Field observations by sampling personnel noted possible fill material in bank samples (Integral, January 2005).

The sample results were compared to the Washington State Sediment Management Standards (SMS) (WAC 173-204) numerical criteria for sediment quality standards (SQS) (12 mg/kg organic carbon for total PCBs) and SMS cleanup screening levels (CSL) (65 mg/kg organic carbon for total PCBs). PCBs at four sampling locations exceeded the SQS, and one station (BK06) exceeded the CSL (Integral, January 2005) (Table 1). Station BK06 is located on the Boeing property just southwest of the Webster Street-Boeing property line and approximately 10 feet southeast of the intersection of the Crowley (Slip 4) and Boeing property line (Seacor, January 2005).

TABLE 1
City of Seattle 2004 Slip 4 Bank Sampling Results
Webster Street Property PCB Soil Sampling

Sample	Total Organic Carbon (%)	Total PCBs (mg/kgDry Wt.)	Total PCBs (mg/kg organic carbon)	SQS EF	CSL EF
BK01	0.96	0.023	2.4	--	--
BK02	8.23	3.8	47 (mean of field duplicate)	3.91	--
BK03	1.75	0.85	28.9	4.05	--
BK04	3.92	0.79	48.6	1.68	--
BK05	4.95	1.42	26.3	2.19	--
BK06	1.94	7.8	402	33.51	6.18

SQS EF (exceedance factor) = concentration sample/Sediment Quality Standard of 12 mg/kg OC.
CSL EF = concentration in sample/Cleanup Screening Level of 65 mg/kg OC.

1.0 Data Quality Objectives

Data quality objectives (DQOs) are defined as the qualitative and quantitative statements that characterize the data needed to support a particular data usage. The overall DQO for this project is to develop implementation procedures that will provide data of known and appropriate quality for the needs identified in the SAP.

Data quality is assessed by PARCC parameters, (i.e., precision, accuracy or bias, representativeness, completeness, and comparability). The applicable QC procedure, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical methods. These are listed in Table 2. The measurement quality objectives (MQOs) for the quantitative PARCC parameters, bias, precision, and completeness are provided in Table 3. Definitions of these terms, applicable procedures, and levels of effort are described below.

Bias is a measure of the error between reported test results and the true sample concentration. Because true sample concentrations are not known, bias is usually inferred from recovery data, as determined by sample spiking. A known amount of analyte (or a surrogate, chemically similar to the analyte) is added to the sample and percent recovery is calculated after analysis.

Representativeness is a measure of how closely the results reflect the actual concentration or distribution of the chemical compounds in the matrix sampled. Sampling plan design, sampling techniques, and sample handling protocols (for example, for storage, preservation, and transportation) have been developed and are discussed in subsequent sections of this

document. The proposed documentation will establish that protocols have been followed and sample identification and integrity assured. Field blanks and field duplicate samples, collected at a minimum frequency of 1 per sampling event or 5 percent (whichever is more frequent), will be used to assess field and transport contamination and method variation. To assess laboratory contamination, laboratory method blanks will be run at a minimum frequency of 5 percent of samples.

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using standard procedures, where available, as well as consistent methods and units. The applicable analytical method and target detection limits listed in Table 2 are consistent with those established in the *Lower Duwamish Waterway Slip 4 Early Action Area Sampling and Analysis Plan for Boundary Definition* (Integral, March 2004). Since data will be compared to numeric criteria set forth in the Sediment Management Standards (WAC 173-204) and the Model Toxics Controls Act (MTCA) (WAC 173-340), the target detection limits are at or below these numeric criteria. Actual detection limits will depend on the sample matrix and will be reported as defined for the specific samples.

Accuracy is an assessment of the closeness of the measured value to the true value. For wastewater samples, the accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. For a matrix spike, known amounts of a standard compound identical to the compounds being measured are added to the sample. A quantitative definition of average recovery accuracy is given in Section 9.2. Accuracy measurement will be carried out with a minimum frequency of 1 in 20 samples analyzed.

Precision of the data is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference (RPD); a quantitative definition of RPD is given in Section 9.2. The level of effort for precision measurements will be a minimum of 1 in 20 samples. For soil and water samples, analytical precision for organic analytes will be established per measurement of matrix spike duplicates. Field duplicate measurements will be obtained to assess overall precision.

Completeness is a measure of the amount of valid data obtained from the analytical measurement system. A quantitative definition of completeness is given in Section 9.2. Under perfect conditions, completeness would be 100 percent. An overall completeness goal for this project has been set at 95 percent. The actual completeness may vary, depending on the nature of the samples. The completeness of the data will be assessed during QC reviews.

TABLE 2
Applicable Methods and Regulatory Limits
Webster Street Property PCB Soil Sampling

Parameter	Analysis Method	MDL (µg/kg dry wt)	MRL (µg/kg dry wt)	SQS (mg/kg organic carbon)	CSL (mg/kg organic carbon)	MTCA Method A (mg/kg dry weight)
Total PCBs [a]	EPA 8082	0.13 – 0.58 [b]	6[b]	12[c]	65[c]	1
Total Organic Content	EPA 9060		0.02 % dry wt.	--	--	--

[a] Sum of all Aroclors including Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260. When no Aroclor is detected, the single highest detection limit will be reported. When one or more individual Aroclors are detected, only the detected concentrations will be summed.

[b] Reported for individual Aroclors.

[c] Sum of Aroclors corrected for organic carbon content.

MDL - Method detection limits.

MRL - Method reporting limits.

EPA SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition, March 1986 and revisions, U.S. EPA.

MTCA Method A – Model Toxcis Control Act Method A Soil Cleanup Levels for Unrestricted Land (WAC 173-340 Table 740-1). PCB mixtures, total value for all PCBs.

SQS - Washington State Sediment Management Standards(SMS) Sediment Quality Standards (SQS) (WAC 173-204-320).

CSL - SMS Cleanup screening level (WAC 173-204-520)

TABLE 3
Measurement Quality Objectives
Webster Street Property PCB Soil Sampling

Analysis	Bias (%)	Precision (RPD)	Completeness
Total PCBs	50-150	± 50	95

4.0 Sampling Requirements (Sampling Design)

As discussed in Section 2.0, previous sampling conducted along the bank below the Webster Street property (samples BK02 through BK06) showed elevated concentrations of PCBs. The objective of this soil investigation is to further identify the source of these PCBs. The sampling strategy for this investigation are as follows:

(1) Collect 3 surface soil samples (0 to 10 cm) at locations near BK06. Sample BK06, located on Boeing property close to the Webster Street/Boeing property boundary,

had the highest PCB concentration at 7.8 mg/kg or 402 mg/kg OC. These 3 samples will be located within the Webster Street property boundary. The purpose of collecting these samples is to verify previous sampling results and to determine whether this could be a localized hot spot. The samples will be analyzed for PCBs and total organic content (TOC).

(0) Collect one surface soil sample (0 to 10 cm) each about 10 feet upland from the top of the bank at locations corresponding to BK02 through BK05. Actual sampling locations will be determined by field conditions. The purpose for collecting these samples is to determine whether the upland soils on the Webster Street property are sources of PCBs to the bank. The samples will be analyzed for PCBs.

5.0 Sampling Procedures

This section describes the procedures that field personnel will use to collect samples, label and package samples, and maintain sampling records. Sampling procedures are detailed in the following subsections.

5.1 Sampling Locations

The proposed sampling locations are shown in Figure 3. Each of these samples will be collected from 0 to 10 cm. These sample locations will have been previously marked. The coordinates of each sample location will be located and recorded using a handheld GPS for future reference. Sample locations will also be documented with digital photographs.

Horizontal control for GPS will be to the North American Datum 1983, adjusted in 1991 (NAD 83/91). Ground elevations (vertical) will be from the National Geodetic Vertical Datum (NGVD). All coordinates will be recorded in the field logbook.

5.2 Sample Collection

The sampling procedures are as follows:

1. Don nitrile gloves prior to collection of each sample.
2. Use a clean stainless steel spoon to collect soil from a depth of 0 to 10 cm. Place sufficient soil directly into the pre-cleaned sample jars provided by the analytical laboratory. Avoid any large rocks, plant material or other material that is not representative of the soil.

7.2 Sampling Tool Decontamination

No decontamination will be necessary since all sampling tools (stainless steel spoons) will be single-use disposables.

5.4 Sample Containers, Preservation, and Holding Times

Table 4 presents the sample containers, preservation requirements, and holding times that will be used or followed for this investigation.

TABLE 4
Analytical Methods, Containers, Preservation and Holding Time Requirements
Webster Street Property PCB Soil Sampling

Parameter	Analytical Method	Container	Preservation	Holding Time
Total PCBs	EPA 8082	8 oz wide mouth glass jar (soil)	4 ± 2° C	14 days
TOC	EPA 9060	8 oz wide mouth glass jar	4 ± 2° C	14 days

5.5 Documentation and Field Observations

5.5.1 Sample Identification and Labeling

All samples will be appropriately labeled for identification and tracking. Sample labels will be completed using waterproof-ink pens and affixed to containers at the time of sampling. The sample designation number will include identifiers that facilitate sample tracking. The sample designation numbers and the proposed locations are listed in Table 5.

TABLE 5
Sample Identification and Proposed Sample Locations
Webster Street Property PCB Soil Sampling

Sample Identification	Proposed Sample Location
FS01-BK02	Soil sample collected 10 feet upland from top of bank at a location corresponding to BK02
FS02-BK03	Soil sample collected 10 feet upland from top of bank at a location corresponding to BK03
FS03-BK04	Soil sample collected 10 feet upland from top of bank at a location corresponding to BK04
FS04-BK05	Soil sample collected 10 feet upland from top of bank at a location corresponding to BK05
FS05-BK06	First soil sample collected near previous soil sample location BK06
FS06-BK06	Second soil sample collected near soil sample location BK06
FS07-BK06	Third soil sample collected near soil sample location BK06
FS08-BK06	Field duplicate of third sample collected near soil sample location BK06
EB-01	Equipment blank

TABLE 5
Sample Identification and Proposed Sample Locations
Webster Street Property PCB Soil Sampling

Sample Identification	Proposed Sample Location

In addition to sample identification, spaces on the label are also provided on the sample identification label to record the following information at the time of actual sample collection:

- Initials of person(s) collecting the sample
- Time of sample collection to the nearest minute
- Requested laboratory analyses

5.5.2 Field Logbooks

The sampling team leader will maintain a field logbook that contains all information pertinent to the FSP. The logbook will include at a minimum:

- Project name
- Project number
- Personnel
- Weather conditions
- Equipment calibration and decontamination
- Health and safety monitoring
- Photograph log
- Sample data
  - Location of sample
  - Date of sample collection
  - Time of sample collection
  - Type of samples taken
  - Sample identification numbers
  - Sampling method
- Personnel decontamination procedures

All members of the field team will use the logbook, make entries in ink, then initial and date each page.

5.5.3 Corrections to Documentation

All entries in field and laboratory notebooks will be written in waterproof ink. No accountable serialized documents will be destroyed or thrown away, even when they are illegible or contain inaccuracies that require a replacement document. When an error is made on an accountable document, the person who made the error will make the correction by crossing a line through the error and entering the correct information. The erroneous information should not be obliterated. Any subsequent error discovered on an accountable document should be corrected by the person who made the entry. All corrections will be initialed and dated.

5.5.4 Chain-of-Custody and Shipment of Samples

The management of samples collected in the field samples involves specific procedures that must be followed to ensure field sample integrity and custody. The possession of samples must be traceable from the time they are collected through the time they are analyzed by the contract laboratory.

The chain of custody of a sample is defined by the following criteria:

- The sample is in a person's possession, or is in his/her view after being in his/her possession.
- The sample was in a person's possession and was locked up or transferred to a designated secure area by him/her.

Each time the samples change hands, both the sender and receiver will sign and date a chain-of-custody form and specify which item(s) has changed hands. When a sample shipment is sent to the laboratory, the top signature copy is enclosed in plastic with the sample documentation and secured to the inside of the sample shipment containers. The second copy of the chain-of-custody form will be retained in the project files. A chain-of-custody record will be completed for each shipping container.

The following information is included on the chain-of-custody form:

- Sample number
- Signature of sampler
- Date and time of collection
- Project name and number
- Type of sample
- Number of containers
- Inclusive dates of possession
- Signature of receiver

In addition to the labels, seals, and chain-of-custody form, other sample tracking components include the field logbook, sample request sheet, sample shipment receipt, and labora-

tory logbook. Before packaging samples, field personnel will make certain that the exterior of the sample container is clean and that the sample label is legible.

The remaining samples are to be held by the laboratory until further notice.

5.5.5 Sample Packaging

Waterproof ice chests and coolers will be used as containers. Coolers may be provided by the contracted laboratory. Samples are to be hand-delivered to the laboratory, the following sample packing protocol will be followed:

- The outside of any wet sample bottles will be wiped with paper towel wetted with distilled or deionized water.
- The cooler(s) will be packed to minimize movement during transport.
- Double-bagged ice will be added as necessary to maintain an internal cooler temperature of 4 °C or lower

Samples will be hand-delivered to Analytical Resources Inc. (ARI) located in Tukwila, Washington. The ARI contact information is as follows:

Analytical Resources Inc.
4611 S. 134th Pl. Tukwila, WA 98168-3240
(206) 695-6200 Phone
(206) 695-6201 FAX
ARI Project Manager: Stephanie Lucas

5.6 Management of Sampling-Derived Waste

Disposable materials generated during the sampling activities will be limited to personal protective equipment (PPE) and single-use sampling tool (stainless steel spoons). All PPE and sampling tools will be handled as solid waste and disposed of accordingly.

6.0 Quality Control Samples

6.1 Field Quality Assurance/Quality Control Samples

Field quality control samples collected will consist of one field duplicate sample and one set of matrix spike-matrix spike duplicate (MS/MSD) samples.

Field Duplicate Sample

Field duplicate sample will be used to determine the natural variability associated with the sampling area, sample handling, and laboratory operations. Blind field duplicate will be collected at 5% (or one sample since the total number of samples is less than 10) of the surface sampling stations. The filed duplicate sample is assigned an unique number and will not be identified as replicates to the laboratory. Field duplicate sample will be collected at the same location following collection of the primary sample.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples

MS/MSD samples will be used to test matrix interference effects on laboratory analyses. MS/MSD samples will be collected at 5% (or one sample since the total number of samples is less than 10) of the surface sampling stations.

6.2 Laboratory Quality Assurance/Quality Control Samples

Extensive and detailed requirements for laboratory QC procedures are provided in the analytical methods that will be used for this project. Every method protocol includes description of QC procedures, and many incorporates additional QC requirements by reference to separate QC chapters. QC requirements include control limits and requirements for corrective action in many cases.

The frequency of analysis for laboratory control samples, matrix spike samples, matrix spike duplicates or laboratory duplicates, and method blanks will be one for every 20 samples or one per extraction batch, whichever is more frequent. Surrogate spikes and internal standards will be added to every field sample and QC sample, as required. Calibration procedures will be completed at the frequency specified in ach method description. As required for EPA SW-846 methods, performance-based control limits have been established by the laboratory. These and all other control limits specified in the method descriptions will be used by the laboratory to establish the acceptability of the data or the need for reanalysis of the sample. Laboratory control limits for recoveries of surrogate compounds, matrix spikes, and laboratory control samples, and for relative percent difference of matrix spike duplicates and laboratory duplicates, are provided in Table 3.

ARI, the laboratory performing the analyses, will be responsible for following the QC procedures established in ARI's quality assurance document as will as the QC requirements established by the analytical method and as defined above. QA/QC requirements will meet or exceed protocols specified in the referenced analytical method.

1.0 Data Management

7.1 Documentation and Records

Laboratory final data package documentation will be as follows. Field documentation requirements have been described in Section 5.

5. Analytical results for environmental samples and field QC samples (field duplicate and equipment blank). The table will contain the following fields: batch; sample_id; date analyzed; date sampled; date lab received; date extracted; lab sample number; analysis class; analysis sequence; dilution factor; parameter name; Chemical Abstracts Service (CAS) number; concentration; qualifier; method detection limit (MDL); reporting limit matrix; percent moisture; units; lab name; and analytical method. If the field is not applicable, then it may be left blank.

6. Internal laboratory QA/QC sample results, including method blank results, laboratory control spikes results, and surrogate percent recovery. The following fields should be listed: batch; date analyzed; date extracted, lab sample number; analysis class; analysis

sequence; dilution factor; parameter name; CAS number; concentration; qualifier; MDL; reporting limit, matrix; units; lab name; and analytical method.

3. Method blank association list. Each method blank should be listed, along with its associated environmental sample identifiers and laboratory identifiers.

7.2 Data Management Procedures

Data management procedures are a crucial part of the data management system. Established procedures are necessary to ensure consistency among data sets, internal database integrity, and a verified, usable data set. The tasks and procedures that will be performed for all project data before they are entered include the following:

- **Data mapping.** The process by which the collected environmental data are selected, marked, and correctly named for entry into the database.
- **Electronic data interchange.** To facilitate data interchange between the analytical laboratory and the data user. Detailed specifications will be developed for both receipt and delivery of electronic data, including data importing and data exporting.
- **Data entry and verification.** The process by which data are correctly entered into the database, including data preparation, data import and entry, and data verification.
- **Data presentation and analysis.** Data from the database may be presented in tabular format.
- **Data administration.** Effective administration of the data management system will reduce the likelihood of errors and ensure the integrity of the database. Data administration tasks include data redundancy control, operation and maintenance of the database, documentation of the data management process, and closing out the data management task in both interim and final stages of completion.

8.0 Audits and Reports

The Project Manager will monitor and audit the performance of the QA procedures. Audits may be scheduled to evaluate the execution of sample ID, sample control, COC procedures, field notebooks, sampling procedures, and field measurements.

If QC audits result in detection of unacceptable conditions or data, the Project Manager will be responsible for initiating corrective action. Corrective actions may include the following:

- Reanalyzing samples if holding-time criteria permit
- Resampling and analyzing
- Evaluating and amending sampling and analytical procedures
- Accepting data while acknowledging level of uncertainty.

Due to the short during of this project, audit of the laboratory is not anticipated.

8.0 Data Validation and Usability

9.1 Data Review, Validation, and Verification Requirements

Field data will be verified during preparation of samples and COCs. Field data and COCs will be reviewed by the field team leader after the field effort is complete. After field data are entered into the project database, 100% verification of the entries will be completed to ensure the accuracy and completeness of the database. Any discrepancies will be resolved before the final data is issued.

Data reviews will be performed at two levels: at the laboratory and outside the laboratory by independent chemists. At the laboratory, 100 percent of the raw and quality control data will be reviewed. Analytical data that are out of specified quality assurance control limits will be flagged as estimated by the laboratory. Outside the laboratory, 100 percent of the quality control data will be reviewed.

9.2 Reconciliation with User Requirements

Following validation, the data will be assessed by the project team. The assessment will include incorporation of the data validation findings into the database by entry of data qualifiers. The assessment will also include review of quantitative DQOs (accuracy, precision, completeness, detection limits) and the preparation of a summary report to present the data results. The final report will include an evaluation of the overall adequacy of the total measurement systems with regard to the DQO of the data generated. These quantitative DQOs are defined below.

Precision

If calculated from duplicate measurements, the relative percent difference can be defined as follows: (1)

$$RPD = \frac{(C_1 - C_2) \times 100}{(C_1 + C_2)/2}$$

where:

RPD	=	relative percent difference
C_1	=	larger of the two observed values
C_2	=	smaller of the two observed values

If calculated from three or more replicates, use relative standard deviation (RSD) rather than RPD: (2)

$$RSD = (s/\bar{y}) \times 100$$

where:

RSD	=	relative standard deviation
s	=	standard deviation
$\bar{y}$	=	mean of replicate analyses

Standard deviation, s, is defined as follows: (3)

$$s = \sqrt{\sum_{i-1}^{n} \frac{(y_i - \bar{y})^2}{n-1}}$$

where:

s	=	standard deviation
yi	=	measured value of the i^{th} replicate
$\bar{y}$	=	mean of replicated measurements
n	=	number of replicates

Accuracy

For measurements where matrix spikes are used, percent recovery can be calculated using the following formula: (4)

$$\%\ R = 100x\left[\frac{S-U}{C_{SA}}\right]$$

where:

%R	=	percent recovery
S	=	measured concentration in spiked aliquot
U	=	measured concentration in unspiked aliquot
C_{SA}	=	actual concentration of spike added

For situations where a standard reference material (SRM) is used instead of or in addition to matrix spikes, the following formula is used: (5)

$$\%\ R = 100x\left[\frac{C_m}{C_{SRM}}\right]$$

where:

%R	=	percent recovery
C_M	=	measured concentration of SRM
C_{SRM}=		actual concentration of SRM

Completeness

Completeness is defined as follows for all measurements: (6)

$$\%\ C = 100x\left[\frac{V}{T}\right]$$

where:

%C	=	percent completeness
V	=	number of measurements judged valid
T	=	total number of measurements

Detection Limit

The method detection limit is defined as follows: (7)

$$MDL = t_{(n-1,1-\alpha=0.99)} \times S$$

where:

MDL	=	method detection limit
S	=	standard deviation of the replicated analyses
$t_{(n-1,\ 1-a=0.99)}$	=	students' t-level and a standard deviation estimate with n-1 degree of freedom

10.0 References

Hart Crowser. July 17, 1996. Additional Independent Remedial Action Report, Former Evergreen Marine Leasing Property - Parcel E, Seattle, Washington. Prepared for Cedar Grove Composting, Inc.

Ecology. October 21, 1997. Letter to Marten & Brown, LLP. regarding Request for No Further Action Determination.

Ecology. May 6, 1998. Letter to Hart Crowser regarding Completion of Groundwater Monitoring.

Ecology. February 2001. *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies.* Publication No. 01-03-003. Revision of Publication No. 91-16.

Integral Consulting Inc. March 2004. Lower Duwamish Waterway Slip 4 Early Action Area Sampling and Analysis plan for Boundary Definition. Prepared for City of Seattle and King County, WA.

Integral Consulting Inc. July 2004. Lower Duwamish Waterway Slip 4 Early Action Area: *Sample Alteration Form.* Prepared for City of Seattle and King County, WA.

Integral Consulting Inc. January 14, 2005. Lower Duwamish Waterway Slip 4 Early Action Area, Revised Draft Technical Memorandum on Proposed Boundary of the Removal Action. Prepared for City of Seattle and King County, WA.

Seacor International Inc. Fax to Craowley Marine Services dated January 31, 2005. Location Survey for Sample BK06.

Hart Crowser. February 2, 2005. Memorandum regarding Environmental Review - PCBs Parcel E- Webster Street Property, Seattle, Washington 17157-00.